MICHIGAN DEPARTMENT OF TRANSPORTATION
BUREAU OF AERONAUTICS - STANDARD SPECIFICATION
P-152
Excavation and Embankment

DESCRIPTION

1.1 This item covers excavation, disposal, placement, and compaction of all materials within the limits of the work required to construct runway safety areas, runways, taxiways, aprons, and intermediate, as well as other areas for drainage, building construction, parking, or other purposes in accordance with these specifications and in conformity to the dimensions and typical section shown on the plans.

1.2 Classification. All material excavated shall be considered "unclassified" unless the Engineer specifies other classifications in the project specification. All material excavated shall be classified as defined below:

(a) **Unclassified Excavation.** Unclassified excavation shall consist of the excavation and disposal of all material, regardless of its nature, which is not otherwise classified and paid for under the following items.

(b) **Rock Excavation.** Rock excavation shall include all solid rock in ledges, in bedded deposits, in unstratified masses, and conglomerate deposits which are so firmly cemented they cannot be removed without blasting or using rippers. All boulders containing a volume of more than 1/2 cubic yard will be classified as "rock excavation".

(c) **Muck Excavation.** Muck excavation shall consist of the removal and disposal of deposits of mixtures of soils and organic matter not suitable for foundation material. Muck shall include materials which will decay or produce subsidence in the embankment. It may be made up of decaying stumps, roots, logs, humus, or other material not satisfactory for incorporation in the embankment.

(d) **Drainage Excavation**. Drainage excavation shall consist of all excavation made for the primary purpose of drainage and includes drainage ditches, such as intercepting, inlets or outlet; temporary levee construction; or any other type as shown on the plans.

(e) **Borrow Excavation.** Borrow excavation shall consist of approved material required for the construction of embankment or for other portions of the work in excess of the quantity of usable material available from required excavations. Borrow material shall be obtained from areas within the limits of the airport property but outside the normal limits of necessary grading, or from areas outside the airport.

1.3 Unsuitable Excavation. Any material containing vegetable or organic matter, such as muck, peat, organic silt, or sod shall be considered unsuitable for use in embankment construction. Material, when approved by the Engineer as suitable to support vegetation, may be used on the embankment slope.

CONSTRUCTION METHODS

2.1 General. Before beginning excavation, grading and embankment operations in any area, the area shall be completely cleared and grubbed in accordance with item P-151.

The suitability of material to be placed in embankments shall be subject to approval by the Engineer. All unsuitable material shall be disposed of in waste areas shown on the plans. All waste areas shall be graded to allow positive drainage of the area and of adjacent areas. The surface elevation of waste areas shall not extend above the surface elevation of adjacent usable areas of the airport, unless specified on the plans or approved by the Engineer.

When the Contractor's excavating operations encounter artifacts of historical or archaeological significance, the operations shall be temporarily discontinued. At the direction of the Engineer, the Contractor shall excavate the site in such a manner

as to preserve the artifacts encountered and allow for their removal. Such excavation will be paid for as extra work.

Those areas outside of the pavement areas in which the top layer of soil material has become compacted, by hauling or other activities of the Contractor shall be scarified and disked to a depth of 4 inches, in order to loosen and pulverize the soil.

If it is necessary to interrupt existing surface drainage, sewers or under-drainage, conduits, utilities, or similar underground structures the Contractor shall be responsible for and shall take all necessary precautions to preserve them or provide temporary services. When such facilities are encountered, the Contractor shall notify the Engineer, who shall arrange for their removal, if necessary. The Contractor shall, at his/her own expense, satisfactorily repair or pay the cost of all damage to such facilities or structures which may result from any of the Contractor's operations during the period of the contract.

2.2 Excavation. No excavation shall be started until the work has been staked out by the Engineer and the Engineer has obtained elevations and measurements of the ground surface. All suitable excavated material shall be used in the formation of embankment, subgrade, or for other purposes shown on the plans. All unsuitable material shall be disposed of as shown on the plans.

When the volume of the excavation exceeds that required to construct the embankments to the grades indicated, the excess shall be used to grade the areas of ultimate development or disposed of as directed. When the volume of excavation is not sufficient for constructing the fill to the grades indicated, the deficiency shall be obtained from borrow areas.

The grade shall be maintained so that the surface is well drained at all times. When necessary, temporary drains and drainage ditches shall be installed to intercept or divert surface water which may affect the work.

(a) **Selective Grading.** When selective grading is indicated on the plans, the more suitable material as designated by the Engineer shall be used in constructing the embankment or in capping the pavement subgrade. If, at the time of excavation, it is not possible to place this material in its final location, it shall be stockpiled in approved areas so that it can be measured for payment for rehandling as specified in Paragraph 3.3.

(b) **Undercutting.** Rock, shale, hardpan, loose rock, boulders, or other material unsatisfactory for runway safety areas, subgrades, roads, shoulders, or any areas intended for turfing shall be excavated to a minimum depth of 12 inches, or to the depth specified by the Engineer, below the subgrade. Muck, peat, matted roots, or other yielding material, unsatisfactory for subgrade foundation, shall be removed to the depth specified. Unsuitable materials shall be disposed of at locations shown on the plans. This excavated material shall be paid for at the contract unit price per cubic yard for unclassified excavation. The excavated area shall be refilled with suitable material, obtained from the grading operations or borrow areas and thoroughly compacted by rolling.

The necessary refilling will constitute a part of the embankment. Where rock cuts are made and refilled with selected material, any pockets created in the rock surface shall be drained in accordance with the details shown on the plans.

(c) **Overbreak.** Overbreak, including slides, is that portion of any material displaced or loosened beyond the finished work as planned or authorized by the Engineer. The Engineer shall determine if the displacement of such material was unavoidable and his/her decision shall be final. All overbreak shall be graded or removed by the Contractor and disposed of as directed; however, payment will not be made for the removal and disposal of overbreak which the Engineer determines as avoidable. Unavoidable overbreak will be classified as "Unclassified Excavation".

(d) **Removal of Utilities.** The removal of existing structures and utilities required to permit the orderly progress of work will be accomplished by someone other than the Contractor, e.g., the utility unless otherwise shown on the plans. All existing foundations shall be excavated for at least 2 feet below the top of subgrade or as indicated on the plans, and the material disposed of as directed. All foundations thus excavated shall be backfilled with suitable material and compacted as specified herein.

(e) **Compaction Requirements**. The subgrade under areas to be paved shall be compacted to not less than the following requirements. The maximum density will be as determined by ASTM D698 for areas as designated for aircraft with gross weights of 60,000 pounds or less and ASTM D1557 for areas designated for aircraft with gross weights greater than 60,000 pounds. The in place density will be determined using ASTM D1556 or ASTM D2167.

When the depth and density requirements have not been specified on the plans, the following shall apply:

Subgrade Under Flexible Pavements

Cohesive Soil - 95% of minimum density for the top 6 inches.

Non-Cohesive Soil - 100% of maximum density for the top 6 inches.

The density and depths of subgrade compaction for dual and dual tandem aircraft will be specified on the plans.

Subgrade Under Rigid Pavements

Cohesive Soil - 90% of maximum density for the top 6 inches.

Non-Cohesive Soil - 100% of maximum density for the top 6 inches and 95% of maximum density for the next 18 inches below the top 6 inches.

Payment for suitable materials removed, manipulated, and replaced in order to obtain the required depth of density will be paid for as unclassified excavation.

Stones or rock fragments larger than 4 inches in their greatest dimension will not be permitted in the top 6 inches of the subgrade. The finished grading operations, conforming to the typical cross section, shall be completed and maintained at least 1,000 feet ahead of the paving operations or as directed by the Engineer.

In cuts, all loose or protruding rocks on the back slopes shall be barred loose or otherwise removed to line of finished grade of slope. All cut-and-fill slopes shall be uniformly dressed to the slope, cross section, and alignment shown on the plans or as directed by the Engineer.

(f) **Blasting.** Blasting will be permitted only when proper precautions are taken for the safety of all persons, the work, and the property. All damage done to the work or property shall be repaired at the Contractor's expense. All operations of the Contractor in connection with the transportation, storage, and use of explosives shall conform to all state and local regulations and explosive manufacturers' instructions, with applicable approved permits reviewed by the Engineer. Any approval given, however, will not relieve the Contractor of his/her responsibility in blasting operations.

Where blasting is approved, the Contractor shall employ a vibration consultant, approved by the Engineer, to advise on explosive charge weights per delay and to analyze records from seismograph recordings. The seismograph shall be capable of producing a permanent record of the three components of the motion in terms of particle velocity, and in addition shall be capable of internal dynamic calibration.

In each distinct blasting areas, where pertinent factors affecting blast vibrations and their effects in the area remain the same, the Contractor shall submit a blasting plan of the initial blasts to the Engineer for approval. This plan must consist of hole size, depth, spacing, burden, type of explosives, type of delay sequence, maximum amount of explosive on any one day period, depth of rock, and depth of overburden if any. The maximum explosive charge weights per delay include in the plan shall not be increased without the approval of the Engineer.

The Contractor shall keep a record of each blast fired--its date, time and location; the amount of explosives used, maximum explosive charge weight per delay period, and, where necessary, seismograph records identified by instrument number and location. These records shall be made available to the Engineer on a monthly basis or in tabulated form at other times as required.

2.3 Borrow Excavation. Borrow area(s) within the airport property are indicated on the plans.

Borrow excavation shall be made only at these designated locations and within the horizontal and vertical limits as staked or as directed.

When borrow sources are outside the boundaries of the airport property, it shall be the Contractor's responsibility to locate and obtain the supply, subject to the approval of the Engineer. The Contractor shall notify the Engineer, at least 15 days prior to beginning excavation, so necessary measurements and tests can be made. All unsuitable material shall be disposed of by the Contractor. All borrow pits shall be opened up to expose the vertical face of various strata of acceptable material to enable obtaining a uniform product. Borrow pits shall be excavated to regular lines to permit accurate measurements, and they shall be drained and left in a neat, presentable condition with all slopes dressed uniformly.

2.4 Drainage Excavation. Drainage excavation shall consist of excavating for drainage ditches such as intercepting, inlet or outlet; for temporary levee construction; or for any other type as designed or as shown on the plans. The work shall be performed in the proper sequence with the other construction. All satisfactory material shall be placed in fills; unsuitable material shall be placed in waste areas or as directed. Intercepting ditches shall be constructed prior to starting adjacent excavation operations. All necessary work shall be performed to secure a finish true to line, elevation, and cross section.

The Contractor shall maintain ditches constructed on the project to the required cross section and shall keep them free of debris or obstructions until the project is accepted.

2.5 Preparation of Embankment Area.
Where an embankment is to be constructed to a height of 4 feet or less, all sod and vegetable matter shall be removed from the surface upon which the embankment is to be placed, and the cleared surface shall be completely broken up by plowing or scarifying to a minimum depth of 6 inches. This area shall then be compacted as indicated in Paragraph 2.6. When the height of fill is greater than 4 feet, sod not required to be removed shall be thoroughly disked and recompacted to the density of the surrounding ground before construction of embankment.

Where embankments are to be placed on natural slopes steeper than 3:1, horizontal benches shall be constructed as shown on the plans.

No direct payment shall be made for the work performed under this section. The necessary clearing and grubbing and the quantity of excavation removed will be paid for under the respective items of work.

2.6 Formation of Embankments.
Embankments shall be formed in successive horizontal layers of not more than 8 inches in loose depth for the full width of the cross section, unless otherwise approved by the Engineer.

The grading operations shall be conducted, and the various soil strata shall be placed, to produce a soil structure as shown on the typical cross section or as directed. Materials such as brush, hedge, roots, stumps, grass and other organic matter, shall not be incorporated or buried in the embankment.

Operations on earth work shall be suspended at any time when satisfactory results cannot be obtained because of rain, freezing, or other unsatisfactory conditions of the field. The Contractor shall drag, blade, or slope the embankment to provide proper surface drainage.

The material in the layer shall be within ± 2 percent of optimum moisture before rolling to obtain the prescribed compaction. In order to achieve a uniform moisture content throughout the layer, wetting or drying of the material and manipulation shall be required when necessary. Should the material be too wet to permit proper compaction or rolling, all work on all of the affected portions of the embankment shall be delayed until the material has dried to the required moisture content. Sprinkling of dry material to obtain the proper moisture content shall be done with approved equipment that will sufficiently distribute the water. Sufficient equipment to furnish the required water shall be available at all times. Samples of all embankment materials for testing, both before and after placement and compaction, will be taken. Based on these tests, the Contractor shall make the necessary correction in order to achieve the correct embankment density.

Rolling operations shall be continued until the embankment is compacted to not less than the

following requirements. The maximum density will be as determined by ASTM D698 for areas designated for aircraft with gross weights of 60,000 pounds or less and ASTM D1557 for areas designated for aircraft with gross weights greater than 60,000. The in place density will be determined by ASTM D1556 or ASTM D2167.

When the depth and density requirements have not been specified on the plans, the following shall apply:

Subgrade Under Flexible Pavements.

Cohesive Soil - 90% maximum density for all layers placed, except the top 9 inches shall be 95%.

Non-Cohesive Soil - 95% of maximum density for all layers placed, except the top 9 inches shall be 100%.

The density and depths of subgrade compaction for dual and dual tandem aircraft shall be specified on the plans.

Subgrade Under Rigid Pavements.

Cohesive Soil - 90% of maximum density for all layers placed.

Non-Cohesive Soil - 100% of maximum density for the top 9 inches and 95% maximum density for all others layers placed.

On all areas outside of the pavement areas, no compaction will be required on the top 6 inches.

Compaction areas shall be kept separate, and no layer shall be covered by another until the proper density is obtained.

During construction of the embankment, the Contractor shall route his/her equipment at all times, both when loaded and when empty, over the layers as they are placed and shall distribute the travel evenly over the entire width of the embankment. The equipment shall be operated in such a manner that hardpan, cemented gravel, clay, or other chunky soil material will be broken up into small particles and become incorporated with the other material in the layer.

In the construction of embankments, layer placement shall begin in the deepest portion of the fill; as placement progresses, layers shall be constructed approximately parallel to the finished pavement grade line.

When rock and other embankment material are excavated at approximately the same time, the rock shall be incorporated into the outer portion of the embankment and the other material shall be incorporated under the future paved areas. Stones or fragmentary rock larger than 4 inches in their greatest dimension will not be allowed in the top 6 inches of the subgrade. Rockfill shall be brought up in layers as specified or as directed and every effort shall be exerted to fill the voids with the finer material forming a dense, compact mass. Rock or boulders shall not be disposed of outside the excavation or embankment areas, except at places and in the manner designed by the Engineer.

When the excavated material consist predominantly of rock fragments of such size that the material cannot be placed in layers of the prescribed thickness without crushing, pulverizing or further breaking down the pieces, such material may be placed in the embankment as directed in layers not exceeding 2 feet in thickness. Each layer shall be leveled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments of rock. These type lifts shall not be constructed above an elevation of 4 feet below the finished subgrade. Density requirements will not apply to portions of embankments constructed of materials which cannot be tested in accordance with specified methods.

Frozen material shall not be placed in the embankment nor shall embankment be placed upon frozen material.

There will be no separate measurement of payment for compacted embankment, and all costs incidental to placing in layers, compacting, disking, watering, mixing, sloping, and other necessary operations for construction of embankments will be included in the contract price for excavation, borrow, or other items.

2.7 Finishing and Protection of Subgrade.

After the subgrade has been substantially completed the full width shall be conditioned by removing any soft or other unstable material which will not

compact properly. The resulting areas and all other low areas, holes or depressions shall be brought to grade with suitable select material. Scarifying, blading, rolling and other methods shall be performed to provide a thoroughly compacted subgrade shaped to the lines and grades shown on the plans.

Grading of the subgrade shall be performed so that it will drain readily. The Contractor shall take all precautions necessary to protect the subgrade from damage. He/she shall limit hauling over the finished subgrade to that which is essential for construction purposes.

All ruts or rough places that develop in a completed subgrade shall be smoothed and recompacted.

No subbase, base, or surface course shall be placed on the subgrade until the subgrade has been approved by the Engineer.

2.8 Haul. All hauling will be considered a necessary and incidental part of the work. Its cost shall be considered by the Contractor and included in the contract unit price for the pay items of work involved. No payment will be made separately or directly for hauling on any part of the work.

2.9 Tolerances. In those areas upon which a subbase or base course is to be placed, the top of the subgrade shall be of such smoothness that, when tested with a 16 foot straightedge applied parallel and at right angles to the centerline, it shall not show any deviation in excess of ½ inches, or shall not be more than 0.05 feet from true grade as established by grade hubs or pins. Any deviation in excess of these amounts shall be corrected by loosening, adding, or removing materials; reshaping; and recompacting by sprinkling and rolling.

On runway safety areas, intermediate and other designated areas, the surface shall be on such smoothness that it will not vary more than 0.10 feet from true grade as established by grade hubs. Any deviation in excess of this amount shall be corrected by loosening, adding or removing materials, and reshaping.

2.10 Topsoil. When topsoil is specified or required as shown on the plans or under item T-905, it shall be salvaged from stripping or other grading operations. The topsoils shall meet the requirements of Item T-905. If, at the time of excavation or stripping, the topsoil cannot be placed in its proper and final section of finished construction, the material shall be stockpiled at approved locations. Any topsoil stockpiled by the Contractor shall be rehandled and placed in its final place without additional compensation. Stockpiles shall not be placed within 200 feet of runway pavement or 100 feet of taxiway pavement and shall not be placed on areas which subsequently will require any excavation or embankment. If, in the judgement of the Engineer, it is practical to place the salvaged topsoil at the time of excavation or stripping, the material shall be placed in its final position without stockpiling or further rehandling.

Upon completion of grading operations, stockpiled topsoil shall be handled and placed as directed, or as required in Item T-905.

The quantity of topsoil removed and placed directly or stockpiled shall be paid for at the contract unit price per cubic yard for "Unclassified Excavation".

Grading operations shall be conducted so that available topsoil will be placed evenly in the top of the grade in proposed turfing areas. Topsoil may be stockpiled or windrowed for convenience, however, no additional payment will be made for later rehandling of such material.

METHOD OF MEASUREMENT

3.1 The quantity of excavation to be paid for shall be the number of cubic yards in its original position.

Measurement shall not include the quantity of material excavated without authorization beyond normal slope lines, or the quantity of material used for purposes other than those directed.

3.2 Borrow material shall be paid for on the basis of the number of cubic yards measured in its original position at the borrow pit.

3.3 Stockpiled material shall be paid for on the basis of the number of cubic yards measured in the stockpiled position as soon as the material has been stockpiled.

3.4 Payment for all excavation specified by the cubic yard measurement shall be computed by the average end area method. After completion of all excavation operations and prior to the placing of base or subbase material, the final excavation shall be verified by the Engineer by means of field cross sections taken randomly at intervals not exceeding 500 linear feet.

BASIS OF PAYMENT

4.1 Payment for "Unclassified Excavation" payment shall be made at the contract unit price per cubic yard. This price shall be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the item.

4.2 Payment for "Rock Excavation" shall be made at the contract unit price per cubic yard. This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

4.3 Payment for "Muck Excavation" shall be made at the contract unit price per cubic yard.

This price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

4.4 Payment for "Drainage Excavation" shall be made at the contract unit price per cubic yard. The price shall be full compensation for furnishing all materials, labor, equipment, tools, and incidentals necessary to complete the item.

4.5 Payment for "Stockpiled Material" shall be made at the contract unit price per cubic yard. The price shall be full compensation for furnishing all material, labor, equipment, tools, and incidentals necessary to complete the item.

Payment will be made under the nomenclature and seven digit item number specified in the plans and proposal for each type of excavation work required per cubic yard, per square yard, or per station, as applicable.

The first three digits of any item number for work included under this specification shall be 152, i.e. 152XXXX.

TESTING REQUIREMENTS

ASTM D698	Test for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5-pound Rammer and 12-inch Drop
ASTM D1556	Test for Density of Soil In-Place by the Sand Cone Method
ASTM D1557	Tests for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10-pound Rammer and 18-inch Drop
ASTM D2167	Test for Density of Soil In-Place by the Rubber Balloon Method